Measurement of Non-flow Correlations and Elliptic Flow Fluctuations in Au+Au collisions at RHIC

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RHIC / AGS Users' Meeting

June 9th, 2010

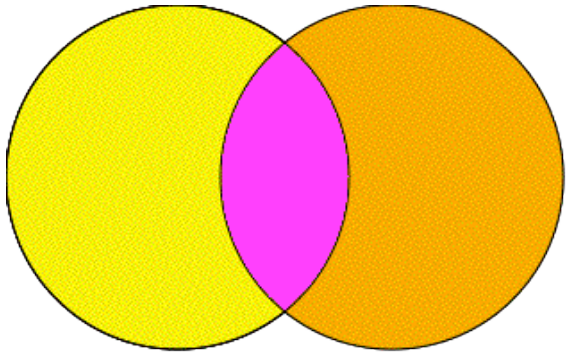
- Event-by-event fluctuations of azimuthal particle anisotropy in Au + Au collisions at 200 GeV
  B. Alver et. al. (PHOBOS), PRL 104, 142301, 2010

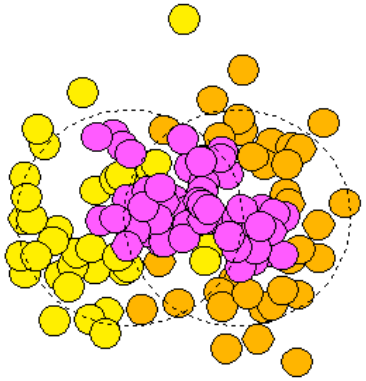
- Non-flow correlations and elliptic flow fluctuations in Au-Au collisions at 200 GeV
  B. Alver et. al. (PHOBOS) PRC 81, 034915, 2010

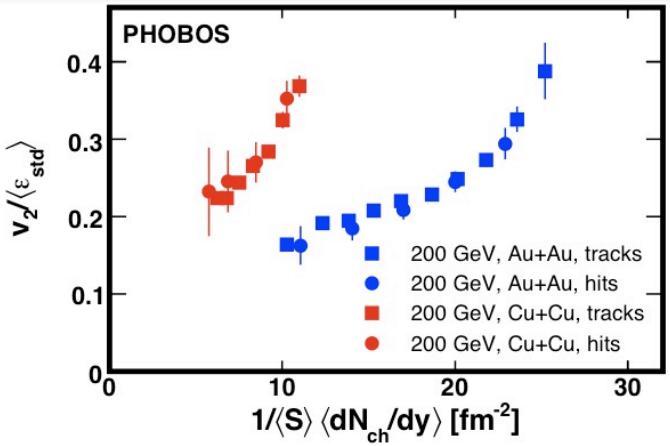
- Collision geometry fluctuations and triangular flow in heavy-ion collisions
  B. Alver, G. Roland, PRC 81, 054905 (2010)

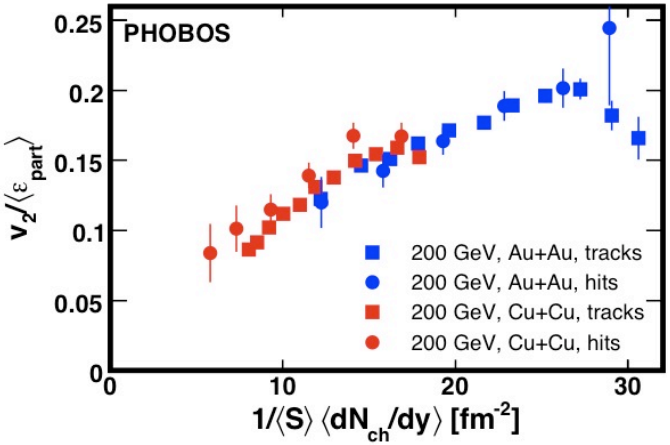
See poster for details.

Motivation







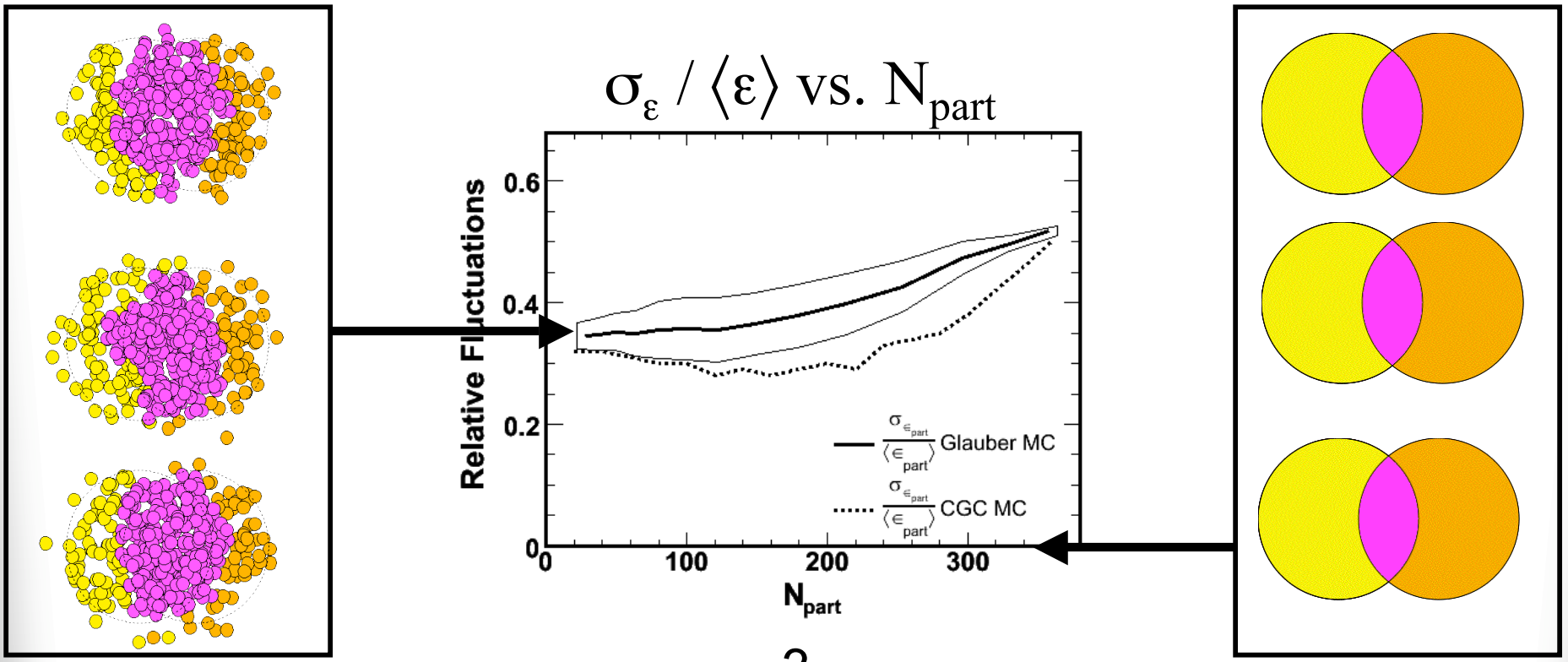


Initial geometry fluctuations reconciles elliptic flow for Cu+Cu and Au+Au collisions.

PHOBOS PRL 98, 242302 (2007)

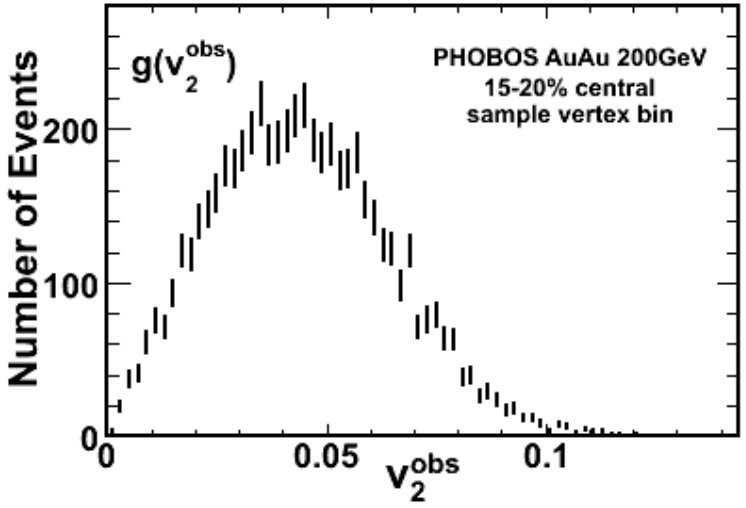
Prediction: Elliptic flow fluctuations

If initial geometry fluctuations are present
v_2 should fluctuate event-by-event
at fixed N_{part} or b



Measuring elliptic flow fluctuations

Event-by-event v_2^{obs} distribution

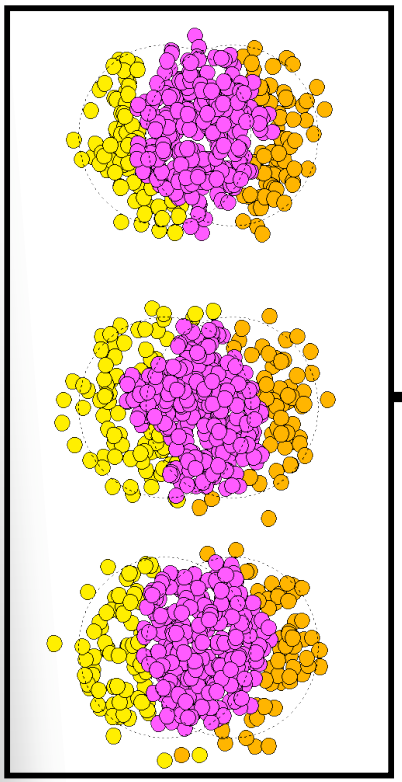


A new methodology has been developed to account for

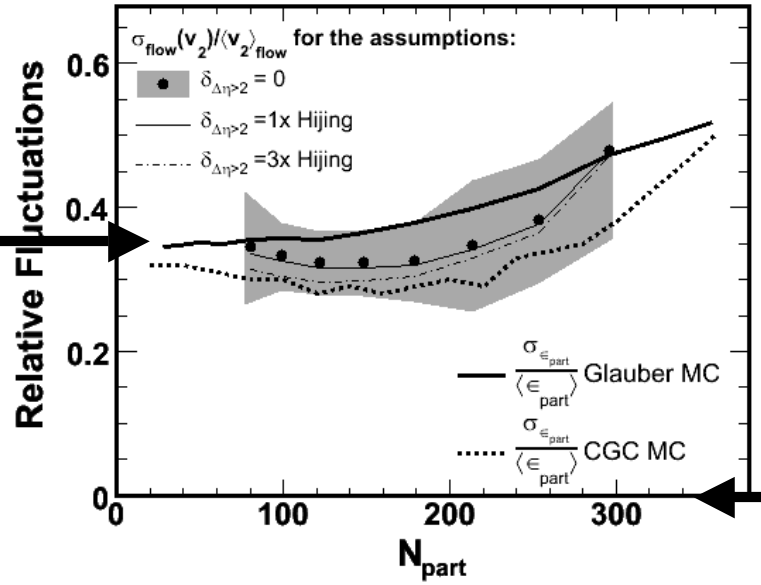
- Statistical fluctuations
- Detector effects
- **Non-flow correlations**

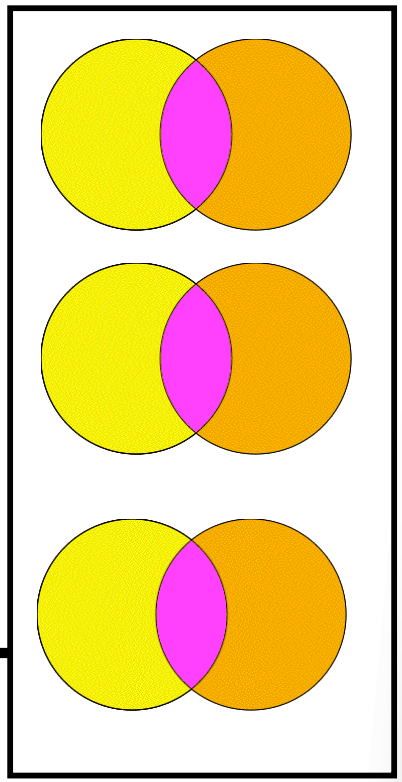
Elliptic flow fluctuations

The measured elliptic flow fluctuations agree with predictions from initial geometry fluctuations.



$\sigma(v_2) / \langle v_2 \rangle$ vs. N_{part}

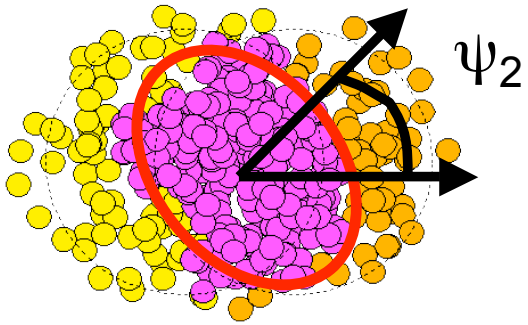


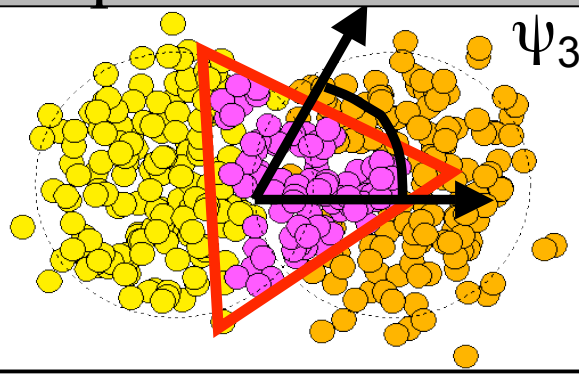


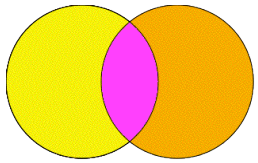
PHOBOS PRC 81, 034915, 2010

Triangular flow

A triangular anisotropy arises in the initial geometry from event-by-event fluctuations which develops a triangular flow analogous to elliptic flow.



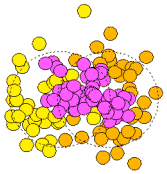




$$\frac{dN}{d\phi} = \frac{N}{2\pi}\left(1 + \sum 2v_n \cos\left(n(\phi - \psi_R)\right)\right)$$

$$v_2 = \left\langle \cos\left(2(\phi - \psi_R)\right)\right\rangle$$

$$v_3 = 0$$



$$\frac{dN}{d\phi} = \frac{N}{2\pi}\left(1 + \sum 2v_n \cos\left(n(\phi - \psi_n)\right)\right)$$

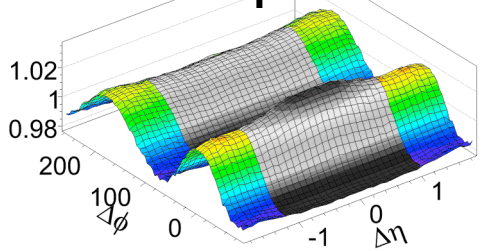
$$v_2 = \left\langle \cos\left(2(\phi - \psi_2)\right)\right\rangle$$

$$v_3 = \left\langle \cos\left(3(\phi - \psi_3)\right)\right\rangle$$

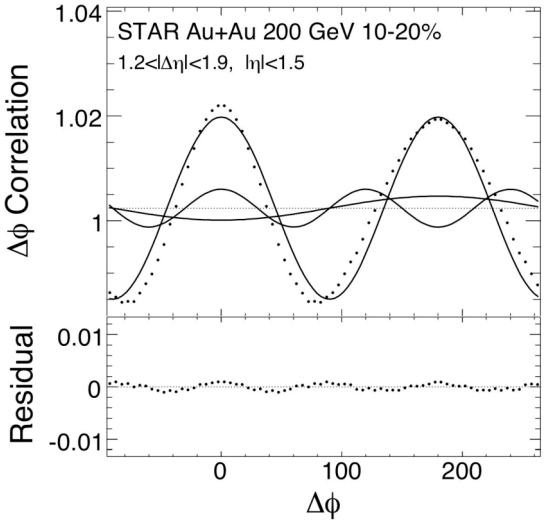
BA, G. Roland, PRC81, 054905 (2010)

Triangular flow in data

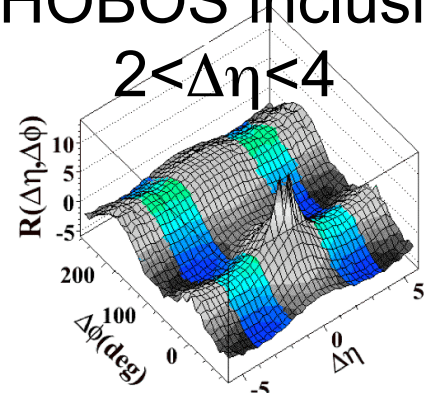
STAR inclusive
$1.2<\Delta\eta<1.9$



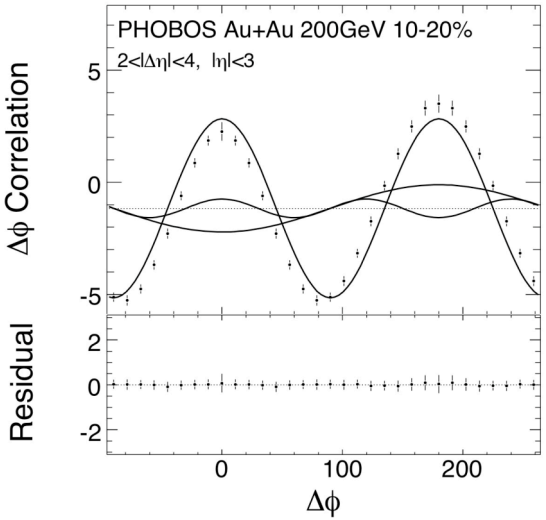
arXiv:0806.0513



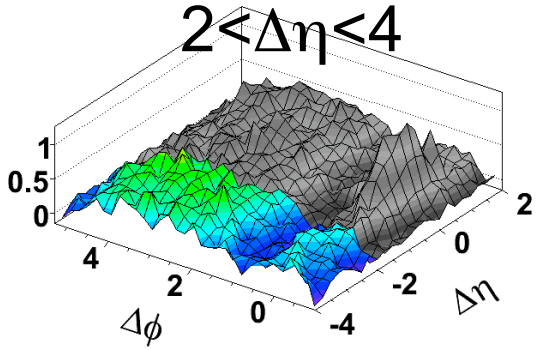
PHOBOS inclusive
$2<\Delta\eta<4$



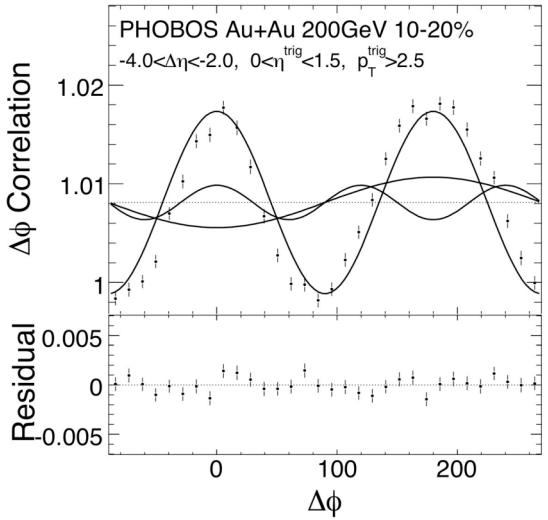
PRC 81, 024904 (2010)



PHOBOS $p_T^{trig}>2$GeV
$2<\Delta\eta<4$



PRL 104, 06230 (2010)



Long range correlations are well described by 3 Fourier Components.

BA, G. Roland, PRC81, 054905 (2010)

Conclusion

- A new methodology has been developed to measure non-flow correlations and elliptic flow fluctuations.
- Initial geometry fluctuations provide a consistent picture of flow and correlations results.
  - System size dependence of elliptic flow
  - Elliptic flow fluctuations
  - Triangular flow (ridge and away side)
- Triangular flow provides a new handle on the initial collision geometry and hydrodynamic evolution of the system.

See poster for details.

Thanks!